DOCUMENT RESUME

ED 361 211 SE 053 637

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TITLE Constraints to Teacher Change.
PUB DATE Apr 93
NOTE 16p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Atlanta, GA, April 1993).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Attitude Change; *Beliefs; Case Studies; *Educational Change; High Schools; Instructional Innovation; *Resistance to Change; *Science Instruction; *Science Teachers; Secondary School Teachers; Student Attitudes; Teacher Role

ABSTRACT

Educational reform is and has been an ongoing process throughout the history of science education. However, with the notion of reform comes constraints or barriers to these proposed changes. Without addressing these constraints reform cannot be full realized. This study was conducted to identify the most significant constraints inhibiting a teacher from reaching his vision for teaching and learning science. Using interpretive techniques, experiences grounded in constructivist beliefs were contrasted with more traditional positivist ideas. Constraints to change were found to occur within a transition zone, a multidimensional area in which change occurs over a period of time. Teachers engaged in change pass through this transition zone. Four types of tangible constraints were identified: physical requirements, associated persons, personal, and student. The most interesting from a research standpoint was the domain of student beliefs. (Author/MDH)

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ED 361 211

Constraints to Teacher Change

A contributed paper proposal for the 1993 annual meeting of the National Association for Research in Science Teaching.

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32306-3032

April 1993

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CONSTRAINTS TO TEACHER AND CURRICULA CHANGE

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Educational reform is and has been an ongoing process throughout the history of science education. However, with the notion of reform comes constraints or barriers to these proposed changes. Without addressing these constraints reform cannot be fully realized. This study was conducted to identify the most significant constraints inhibiting a teacher from reaching his vision for teaching and learning science. Using interpretive techniques, experiences grounded in constructivist beliefs were contrasted with more traditional positivist ideas. Constraints to change were found to occur within a transition zone, a multidimensional area in which change occurs over a period of time. Teachers engaged in change pass through this transition zone. Although many tangible constraints were identified, the most interesting from a research standpoint was the domain of student beliefs.

Introduction

Despite recommendations from nation-wide studies during the 1980s the state of science education in the U.S. has not changed to any great extent. For example, evidence obtained by the National Assessment of Educational Progress shows little overall change in what U.S. students know and can do in science. Average science proficiency among 9- and 13-year-olds was the same in 1990 as in 1970. For 17-year-olds, proficiency decreased. (National Commission on Excellence in Education, 1983) So one question is, why are recommendations for improving science education, set forward in national reports, seemingly ignored? We believe this stalemate persists as a consequence of the issuance of recommendations without addressing the constraints or obstacles to recommended change. We sense that identifying and addressing these constraints are critical steps of any reform process and will inevitably determine the extent of reform at various levels. Based on the belief that a study of a single classroom has significance at national and local levels, we conducted a case study to identify some constraints to change in a high school science classroom.

Theoretical Rationale

We made sense of our data based on the belief that learning is an active rather than a passive process. Additionally, it is a social process of making sense of experiences in terms of what is known already (Tobin, 1991). Since knowledge is always the result of a constructive activity, it cannot be transferred to a passive receiver. In keeping with this belief the teacher's role changes from that of a dispenser of knowledge to that of a facilitator of the process of knowledge construction. The student's role also changes from an empty vessel needing to be filled to an actively cognizing being.

Purpose

The following study was undertaken to identify constraints encountered by a teacher in the midst of referent change and ways in which this teacher was able to overcome or work within these constraints. This study would assist the teacher to recognize constraints which were inhibiting or discouraging personal changes in his beliefs and subsequent actions in the classroom.

The Study

We began our study by focusing on the following questions:

1) What are the teacher's current stated rationale for teaching and learning science, and how does this differ from his previous rationale?

2) How do actual classroom teaching and learning activities correlate with this teacher's vision?

3) What constraints inhibit or discourage this teacher from reaching his vision?

4) How does this teacher work with or overcome these constraints?

We were forewarned of the rather divergent nature of interpretive research by others who do classroom research. For example, Brickhouse (1991) notes,

> It must be recognized that these questions will serve to guide the study. One of the features of many qualitative designs is that the questions, observations, and theories emerge as the study progresses. Determining at the onset all the questions and procedures for the study is neither possible nor desirable. Research in the field can

> never follow a set of rigidly defined procedures, it must always remain flexible. Not only does the research design unfold during the progress of the research, but the relationships between the participant's understandings and feelings about the research often develop as the research progresses (p. 95).

As Brickhouse suggests, additional questions or directions may evolve from our initial inquiries.

The Study

Fortunately, we identified a teacher who we thought was still somewhat traditional in his approach to teaching. This teacher had indicated an interest with respect to changing his referents for teaching science. The teacher's name was Eric and he taught grade 9 general science and grade 10 general biology. However, before we could begin to collaborate with Eric we were required to meet with an administrator to receive authorization to conduct a study in the school. We met with the principal and described our area of interest. He was very receptive to our idea for identifying constraints to teacher change and felt that all of us could benefit from a study of this nature. The principal spent time describing the school, the teacher, and the classes Eric taught.

This school was quite different from those we had previously taught in. Teachers were encouraged to try innovative approaches to teaching, and many new curricula programs and materials were trial-tested there. In addition, prospective teachers could observe classes and obtain valuable teaching experience. This K-12 school attempted to mirror the heterogeneous population of the State of Florida. Students came from several counties and all sections of the city. They were computer-selected and had to be accepted into the school. Additionally, the principal mentioned that 2/3 of the grade 9 students had come from their middle-school program and were used to the Science Plus curriculum. This curriculum encouraged a hands-on approach to doing science. He explained that, in contrast, the other 1/3 of grade 9 students came from other county schools where classes were predominantly "teacher-directed with limited creativity". He went on to describe Eric's classes. He referred to the composition of the biology classes as homogeneous, however, grade 9 was a heterogeneous group. This difference was most likely a result of their different middle school experiences. We deduced from these statements that by the time they reached tenth grade somehow these differences were seemingly dispelled.

We mentioned that we were particularly interested in working with the Biology course since this was where our strengths, interests and experiences were. However, the principal felt that it would be beneficial for us to observe a grade nine general science class, in addition to a biology class. He explained that they did not have a strong grade 9 science program, and there were many different opinions regarding the structure and function of this course. Perhaps, outside observers would give a different perspective.

With the principal's support we scheduled a visit with Eric to discuss the essence of this proposed study. During this visit we found that Eric was a 35 year-old male with nine years of teaching experience at the middle and secondary school levels. We explained to him that by observing and collaborating with him and his students we could develop a clearer understanding of the constraints teachers encounter as they attempt to implement change. This study would take the form of a case study where his case could extend our opportunity for learning and reflection. His experiences could take us beyond the limits of our own prior experiences (Shulman, 1988).

We were delighted when Eric agreed to cooperate in the study. He felt that it would also give him opportunities to reflect and become a researcher in his own classroom. Schon (1983) explains that reflective practices can help in fostering professional change. He notes that often when a professional reflects, it is done in isolation. Situations may become so familiar that any contradictions are difficult, if not impossible, for the individual to identify. Reflecting with another may bring to light these inconsistencies.

We also discussed the nature of the study. The study would consist of: more than 30 in-class observations; transcribed interviews with the teacher; classroom and personal narratives; notes from casual conversations with students and with Eric; written comments from the students; and access to assignments and tests. This extensive set of data would provide us with a rich account of what was happening in the classroom. Eric would have access to all of these data.

We discussed Eric's role as a co-researcher. It would be important for him to reflect and identify areas of his actions and his students' actions which would merit further observation and discussion. Interactive sessions with him would provide opportunities to discuss the collected data. We felt it was essential and ethically considerate to mutually consent on subsequent observations and discussions with others who may be directly or indirectly involved. By analyzing and interpreting the data we would be able to identify patterns of activity or thought. Based on these patterns we would negotiate conclusions or assertions with respect to what was happening in Eric's classroom. Once these assertions and conclusions were identified, it would be important to verify whether they justly described what was happening. This would involve returning to the classroom to try to negate our findings. If we could not disprove them we would be assured that our findings were conceivably viable. This method was in compliance with APA guidelines.[1]

TIMELINE

This study began in January 1992 and is still continuing. The first four months were spent in the classroom. During this time we observed the classroom in its natural settings. Any interactions with the students took place from January 1992 to April 1992. Six formal interviews with the teacher were conducted. From September 1992 to March 1993 we concentrated on transcribing the observations and interviews, continued discussions with Eric, sought to identify patterns within the transcriptions and documented our findings.

ERIC'S VISION

During our initial meeting, Eric described his existing approach to teaching and learning science and touched upon his experiences, which were pivotal to the development of this approach. Eric began teaching in the high school in which he had been schooled. He taught upper-level students who listened, asked questions and understood. He appeared to have fit in well with the culture and goals of the school and commented that people thought that this "person was a good teacher". An indication of the nature of science taught at this school appeared in a comment made during this initial meeting. As a student, Eric said he had had few "real" science experiences and until grade 11 he had no hands-on experiences. His course content was determined, to a great extent, by county course descriptions.

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[1]Except in minimal risk research, the investigator establishes a clear and fair agreement with research participants, prior to their participation, that clarifies the obligations and responsibilities of each. The investigator has the obligation to honor all promises and commitments in that agreement. The investigator informs the participants of all aspects of the research that might reasonably be expected to influence willingness to participate and explain all other aspects of the research about which the participants inquire (APA, 1981, p. 638).

In contrast, Eric's present school allowed for a great deal of professional freedom in determining the course curricula. We are using the term curricula to represent the set of planned objectives for the courses. Teachers were not obligated to follow detailed county course descriptions. Eric described his vision of teaching in this setting in the following manner:

> I envisioned classes that were very conducive to research, pliable to a certain extent, flexible...new ideas, new ways of thinking, just flexible...open to change... Students need to develop personal responsibility, flexibility, and consciousness to the domains of science. All citizens should be able to make decisions on science-related questions that impact their lives. The teacher's role is to foster the development of these responses and to show concern for the lack of acceptance or initiative in these areas.

A clear dichotomy exists within these descriptions. Eric explained that his teaching was based on his own personal experiences, those as a student and those as a teacher. This conceptualization of science teaching, which he had taught according to, was a very "real" and concrete image. It was grounded in personal experiences. In contrast, his vision was simply that, a vision. His vision was built with ideas from readings, discussions, lectures, educational reform documents, and others' testimonies and expectations. This vision was not grounded in concrete personal experiences. As a result Eric lacked an actual teaching and learning model of science education to which he could refer.

Eric's existing approach had been successful in other schools and he perceived his vision as being potentially more successful. Success in this first case, referred to students who "listened, asked questions, and understood". In the second model, students would be creative, autonomous and critical thinkers. In addition, the teacher's role was quite different, shifting from that of a dispenser of knowledge to a facilitator of autonomous learning.

Having presented one of the key tensions that make up Eric's context, we feel comfortable proceeding with our three assertions.

ASSERTION #1

Teachers engaged in change pass through a Transition Zone. "Transition zone" refers to a multidimensional area in which change occurs over a period of time.

When we began this study and were contemplating the idea of teacher change and the accompanying constraints,we anticipated these changes to occur over a period of time. Initially, we felt confident in verbalizing this belief, however, we did not have a visual image of how this change would occur over time. Through a combination of observations and conversations with Eric and his students, an image began to evolve. Some features of the image are well defined while others are still absent or blurry. This image evolved during the course of the study and is still evolving. We have called this period of time and space in which change occurs the "transition zone".

Each of these words, transition and zone, generates conceptual images. "Transition" indicates change. This change or transition to a new manner of thinking or doing may occur rapidly or slowly. The catalyst for change may originate from within one's self or it may be external from one's self. The change may be superficial or deep-seated. The term "zone" generates images of environments such as a "construction zone" and "school zone". Each of these zones represents a multidimensional area with associated boundaries. Persons associated with these zones cross these boundaries constantly, entering and leaving the zone. In the "school zone" these persons may be students, teachers, parents, student interns, and various other visitors. Travelling within the zones' boundaries takes time and is done with caution. Together these terms, "transition zone", depict change occurring within a multidimensional area, over a period of time.

Eric's transition zone began when he entered his present school. The beginning of the

study represented a point within his transition zone. This point symbolized a new phase of the change process. As we mentioned earlier, reflection with another can foster change. Often, when a professional reflects in isolation, situations may be so familiar that any contradictions are difficult, if not impossible, for the individual to identify. We believed that collaborative reflection would bring to light these inconsistencies and bring Eric closer to his vision. To reach this vision, the end of his transition zone, Eric would have to travel through this multidimensional area over a period of time.

Constraints to change can occur at any time within this zone. The number of constraints and manner in which they are dealt with will determine the time needed and ease with which the vision is attained. Although we believe that this concept of a transition zone may be common to those undergoing change, we also believe that each individual's transition zone is unique. The pattern of constraints may not be identical for each individual.

Initially, we envisioned Eric's anticipated process of change to progress in a straight-forward direction. We believed that constraints would either be overcome or worked with and Eric's vision would be reached.We also believed that several factors within the school environment would facilitate this change. As we mentioned earlier, this school allowed for a great deal of professional freedom to determine the course curricula. In addition, many approaches to teaching and learning were trial-tested there.

Surprisingly, this was not what we observed. After a number of classroom observations, we detected a pattern of activity in Eric's approach to teaching. Not far into our observations, after watching Eric's interactions with his students, we wrote down, "inconsistency, some contradictions, and students are somewhat confused". Comments such as these continued to appear throughout our notes. From these comments it was apparent that Eric seemed to be fluctuating between teaching approaches. The following description may help you to visualize this pattern.

We previously quoted Eric's vision as that of a research-oriented classroom where students were autonomous, accepting personal responsibility for their learning. In moving towards his vision Eric employed a number of approaches designed specifically to promote or encourage this personal responsibility in his students. As we observed his classes, we identified several of these novel approaches. For example learning contracts and self-evaluations were used, at the beginning and end of the grading periods, respectively. Students were also expected to do research on topics within a defined range, such as "Disease". In another example, students were responsible for discussing an article they had chosen. During the class time allotted, Eric instructed his students to get together with a partner and discuss what they had learned in their articles. When it was time for presentations students were to present what they considered to be the most important items they had learned. Following these presentations discussions about the subjects ensued. While each student was presenting their article, their classmates were to complete the following three questions and statements. Eric stated that he was looking for what each of them learned personally. The three questions and statements were "#1 I have learned..., #2 I still have questions on..., and #3 Possible topics for group research." Other teaching approaches to promote personal responsibility for learning included, peer evaluation, group work and negotiation of classroom rules. To Eric, all of these were important components of the learning process.

However, on a number of occasions, it appeared that many students were not accepting responsibility for their personal learning. Class time was not being used efficiently. Off-task discussions were consistently taking place. Young ladies used time allotted for discussion and group work to apply their make-up and brush their hair. One young man used this time to sell candy items from his backpack. When we asked what his profit margin was he replied "100%". Perhaps, he was more interested in mathematics and economics. This off-task behavior was often deemed inappropriate by both the teacher and students. Attempts were made, by Eric and the

students, to negotiate what sort of behavior would be accepted in class. Together, the class discussed the question of whether one of the criteria for grades should be class behavior. The class was divided, with some students expressing the feeling that behavior in class should be considered in their grade while others felt that their grade should be based solely on academic achievement. To deal with this dilemma, Eric would intersperse objective tests and assignments among his novel assignments. By implementing these approaches he was able to measure objectively whether his students had covered and studied certain material.

We discussed these fluctuations, at some length. At one point, we described this pattern as resembling that of an electron going from a highly unstable state to a more stable state and back again. It appeared as if this modified approach to teaching and learning paralleled the unstable state whereas Eric's existing approach resembled the stable state or perhaps, a comfort level. Consciously or unconsciously, Eric would return to this familiar approach, and take on a role he was familiar and comfortable with and by some standards, a successful model. Rather than progressing along a straight path towards his vision, Eric would often return to familiar approaches to teaching. Eric's process of change began to resemble a roller coaster through the transition zone rather than a straight forward path (See figure 1). It is important to note that Eric did not see these regressions as returning to an unsuccessful approach to teaching but rather a return to an approach that had been successful in the past. Unfortunately, others did not see this trend in this same light. A regression to a more objective approach to teaching was seen as rather unsuccessful and noncreative. Assertion number two looks at the types of constraints which influenced the course of this process.

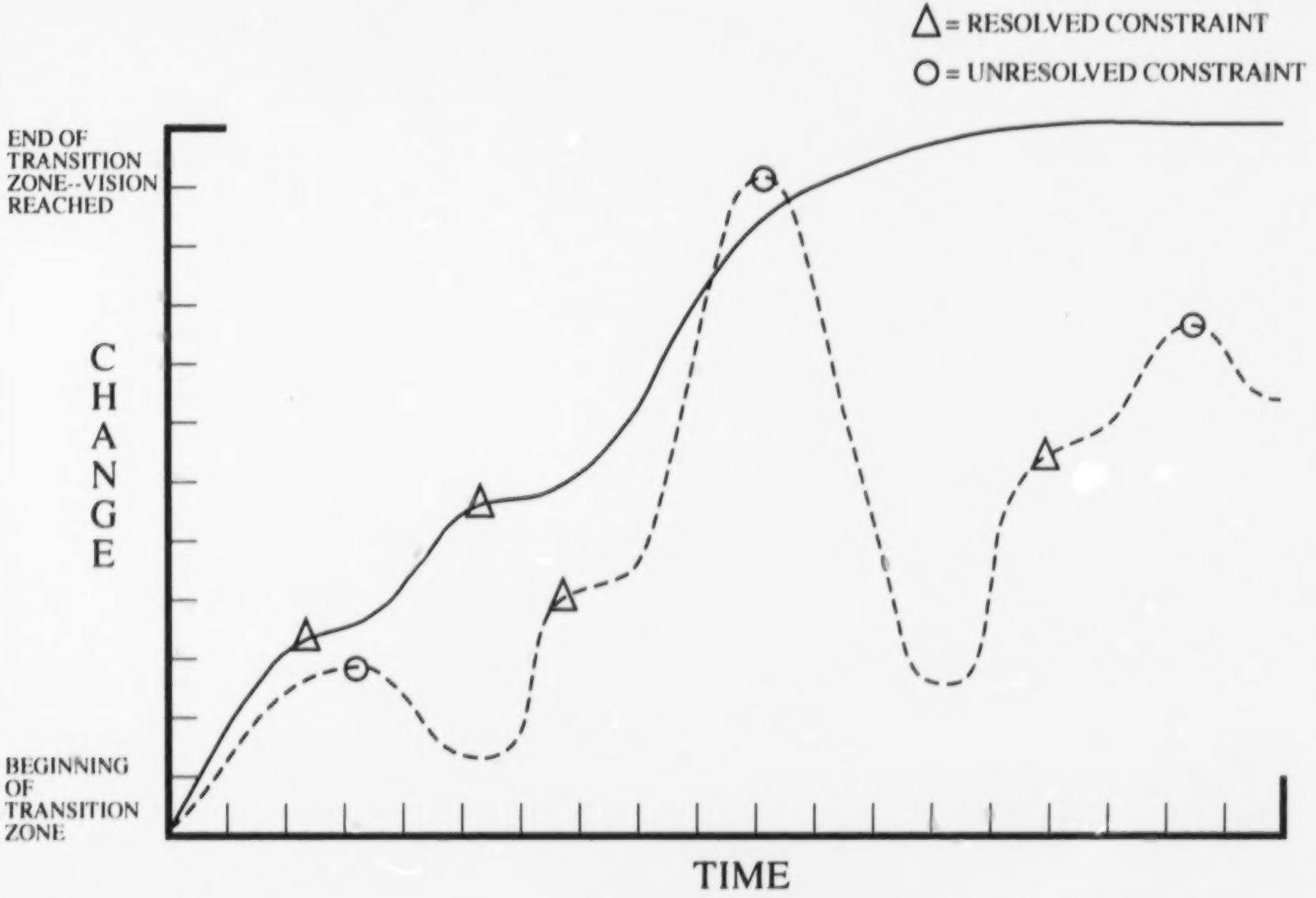
ASSERTION #2

Generally, constraints to teacher change may fall under two umbrellas of classification. Primary constraints are the most vivid and easily identifiable constraints. Secondary constraints are latent and often difficult to identify due to their context-specific nature.

We believe constraints to change are individual constructs and if there is a will to work with or overcome them a way will be found. However, we also believe that many factors are influential in these constructions and consequently, in the ability to deal with them. To overcome or work with constraints it is essential to answer two questions, "What is the constraint?" and "What factors were significant in its construction?" An examination of how and why the constraint was constructed can be helpful in ascertaining ways in which the constraints can be dealt with. The complexity of the construction may determine whether or not the constraint is dealt with and the ease with which it is dealt with.

Just as dealing with constraints can be simple or complex, so can the process of identifying them. Often, constraints are easy to identify. We have called these constraints "primary constraints". An example of a primary constraint is lack of funds. For most science teachers a yearly budget of $200 for 5 biology classes is an easily constructed and identifiable constraint to doing activities needing disposable materials. In contrast, constraints may be latent and difficult to identify. We have called these "secondary constraints". Unlike primary constraints to change, secondary constraints may be difficult to detect largely because of their uniqueness or context-specific nature.

The following pages contain those constraints which Eric, himself, immediately identified as well as constraints which were not obvious. We have divided these constraints into the following categories: physical requirements, associated individuals, personal, and student. These categories can be identified within most teaching and learning environments. However, the specific examples which we will share are context-specific, having traits unique to Eric's situation. We have only briefly referred to student constraints in this section since they will be the focus of Assertion #3.


△ = RESOLVED CONSTRAINT
○ = UNRESOLVED CONSTRAINT
END OF TRANSITION ZONE--VISION REACHED
CHANGE
BEGINNING OF TRANSITION ZONE
TIME
——— = ANTICIPATED PATH OF CHANGE
- - - - - - = MODEL OF ERIC'S PATH

Physical requirements - During our initial meeting Eric discussed constraints which he felt were significantly hindering his attempts to reach his vision. Eric had strong views about the inadequacy of the classroom, particularly its laboratory facilities. He felt that he had very little room for storage, a shortage of laboratory equipment, dangerously small laboratory areas and only two electrical outlets which worked. He also explained that the budget for science equipment was frozen and that only those items that were crucial should be ordered.

Other Associated Individuals - In his book, "The Reflective Practitioner", Schon (1987) describes a condition, "professional pluralism" in which competing views of professional practice exist. He notes that the predicament for the practitioner is to choose among multiple approaches to practice or devise his own way of combining them. Metaphorically, he describes this condition as a "babble of voices". Eric vividly described a situation much like this. Societies composed of students, parents, and persons of Academe and administration held definite images of effective teaching. In addition, the teacher's past experiences represented a strong voice. These experiences will be discussed further in the section titled "Personal Constraints". The following passage is a clear example of the multiple voices Eric was experiencing.

> I've had very little, what I would consider comprehensive feedback about what goes on in my class...From students, from parents, from administrators, I've always had positive feedback really until I got here. What I have gotten here I consider to be a lot of mixed signals, ... I got here and I was told one thing, what I consider one thing from this Principal, another thing from the Vice Principal...you get a lot of different signals. There's a saying that there are too many chiefs and not enough Indians...Everybody thinks they know what needs to be done but no one that is in a leadership position will sit down and comprehensively work this out.

Eric reflected on the difficulty of having this "professional pluralism" to contend with, although he did not use this exact phrase.

> I look at a lot of different angles and a lot of different things and maybe it would be better if I was more straight-forward and just did it regardless of the repercussions...I don't know. That's one area that needs to be developed. How do you do something, when you have the personality of trying to please everyone and in the process of trying to please everyone you please no one. I think that's where I am. Trying to succeed on a personal and professional level and in the process not pleasing anyone.

As these passages indicate, this "professional pluralism" or "babble of voices" was a multi-faceted, complex constraint. It made prioritization an extremely complicated process.

Personal - Eric discussed a number of personal constraints which he felt hindered his progress towards his vision. He identified time as a constraining factor. He had 4 different preparations, 5 classes and a total of 150 students. In addition to Eric's commitment to teaching, he also had commitments to his family, his church, and his program of graduate study. Time was a precious commodity. Eric felt that he needed time above and beyond that which he had previously required to plan classes, to create learning environments for his students, environments which he, himself, had not experienced. These experiments, as Eric referred to them, took time. Time to plan, reflect upon and re-evaluate. Each experiment was a new learning experience for him and required time to test and refine.

A second personal issue which Eric had not resolved was his role as a teacher. The roles that Eric had filled in the past were no longer appropriate or acceptable. A role of "all-knower" or "captain-of-the-ship" were not suitable metaphors for this vision. Metaphorically, Eric saw his new role as a "facilitator of learning". But, what did this role entail? Eric did not have a clear image of this capacity. He struggled with questions such as, "How should I handle homework? Classroom discipline? Late assignments? Evaluation? Am I being flexible enough or am I being too flexible?" Eric found it extremely difficult to give the responsibility of a traditional teacher, an

all-knower, disseminator of knowledge and disciplinarian and handing it to a 14 year old and hope that the student would accept responsibility for their own learning of science.

Student - We began to ask ourselves how students perceived this whole process of change. There seemed to be many complaints and little motivation by many students to accept responsibility for their personal learning? But, why was there frustration and resentment towards the teacher and the curriculum? Assertion #3 examines the diversity of students in Eric's classes and their reactions to the process of change.

ASSERTION #3

Students will not necessarily share the teacher's vision of the need for change. What has worked for them in the past may be satisfactory.

Traditionally, a student's role could be metaphorically referred to as a "vessel needing to be filled". Students entered classes as blank slates expecting to be filled with knowledge. Common to this learning environment are notes on the board, and objective reading assignments and evaluations. In contrast, Eric expected his students to be self-motivated and to have developed independence, self-control, autonomy and personal responsibility for their learning. However, in this more student-centered, research oriented learning environment some students appeared to thrive while other students seemed to flounder. As we mentioned previously, in Assertion #1, some of Eric's students seemed to have difficulty understanding and accepting both the teacher's new role and their own role. Student reactions to this dilemma were diverse. Frustration was expressed in the form of lethargy, rebellion, resistance and/or confusion. We had not anticipated these reactions. The following reflection evidences what Eric was experiencing in his classes. His students were asked to examine a science concept, such as heat, which a technological device was founded upon. In addition, they were to illustrate an experiment which demonstrated this concept. Eric explained:

> They (the students) are welcome to devise or construct an experiment or they can go to a book and say this illustrates what we are going to do. But, not many of these people are even going to attempt to do their own experiment. I would think that it would be wonderful if they could do that but, they are not willing to try. They would rather sit there and mumble than even attempt. You would think between 3 or 4 people you could start to think about, what they had seen in this area before, what they had done in this area, or what this book was showing...What I would like to see is a group generally try to come up with some questions and say, Hey, Mr. Carlton, this is what we've done, these are the questions that we have, this is what we still need to do" and then ask for help but instead you've got groups saying "I don't know what you are talking about. I don't know what to do." and nothing is accomplished...They are unwilling to really take some initiative and think through some of these things and then say "this is the problem and this is what we have thought about"...Some of the groups are doing that.

In this dialogue Eric talks about the lack of motivation of some of his students to accept this responsibility. In this next dialogue he discussed reasons why he thought they were not accepting this role.

> I really get the impression over and over again that they (the students) are so used to teachers telling them exactly what to do. I have students in my Biology class who would just like me to fill the board with notes, give a test and go on. They could care less about whether they understand it or not, or whether it's personal learning...I think maybe that's a point that a lot of these students are looking for and I can understand that. It would be nice to be able to do x amount of work and say you're finished but, as you have seen with your research and I think as anyone who has done research sees your job is never really over. It

> just continues and where you stop becomes a real key to how much you have learned. You see some groups really are continuing, sort of building on what they are doing.

It appeared as though some students did not "buy into" this approach to learning or share the teacher's vision of the need for change. Eric believed that many of them were accustomed to and comfortable with the traditional student role.

As a response to this mixture of reactions, Eric began to question his decision of providing unprecedented amounts of autonomy and independence to his students. These approaches were intended to enable his students to express themselves, influence the nature of the course which included classroom protocol and evaluation, and direction and extent of their personal learning. However, he stated that many of his students really did not know what to do with themselves, in terms of managing their time and acting responsibly in the classroom when given the opportunity to work in groups or investigate a personal area of interest. Students who did not accept this responsibility in a mature and serious manner often disturbed the learning of other students. Eric felt that because his students were not yet accustomed to this new role it was his responsibility to continue to be an authority figure when classroom discipline became problematic or students did not assume their roles as learners seriously. He discussed this dilemma in the following dialogue.

> It's kind of hard to find the limit, in terms of how much freedom should you give a person, how much direction. I'm used to giving a lot more direction than I am here. It frustrates me to sit back and watch them as they flounder, but at the same time, some are doing very well, so obviously learning is taking place. It may be more learning than if you gave them, x amount of material to learn, hand outs or whatever, and said we'll have a test on this, on such and such a day.

As you have probably inferred, Eric had many questions and choices to make during his transition. Was the decision to expect each student to adopt a new role for learning ethically sound? Is it economically and socially astute to encourage each child to pursue their own personal interests perhaps disregarding the economic needs of society? Will Eric inevitably reach his vision of a research-oriented classroom? Is this a practical approach to teaching in public schools? These are a few questions to consider as we turn to our discussion of this study.

Discussion

Eric had always been known as a good teacher. He considered himself to be competent, knowledgeable, amiable, and professional. However, when Eric decided to change his referents for teaching and learning science he would question these beliefs and often the vision which he was moving towards. He did not fully anticipate the tumultuous transition that would accompany his decision.

A change seemed simple enough in the beginning. We felt that his Eric's present teaching environment would allow for a rather unobstructed transition to his vision. However, as time passed this process did no progress as smoothly as he once had envisioned. Eric's journey through his transition was characterized by many fluctuations between teaching approaches. Upon encountering an unresolvable constraint he would return to an approach to teaching which he had considered successful in the past. Unfortunately, others around him did not always see this as successful teaching.

Four types of constraints were identified during the course of the study: physical requirements, associated persons, personal and student. Although each of these categories could be regarded as universal, likely to be found in all learning environments examples within these categories are quite unique or context-specific. Although Eric may construct time as a constraint his construction may be very different to another's construction

We were extremely surprised to find students as a category. Often we assume that students will understand and willingly change in response to our need for change. However our need for change may not be perceived and appreciated by all students. Tobin (1990) states, "When teachers act in the classroom they do what makes sense to them in the circumstances." He then proceeds to note, "What has worked in the past and seems likely to be effective in a given context are among the criteria that guide a teacher's selection of appropriate practices." Can this also be said of the student? Certainly. Students, like teachers, will learn according to past experiences. These prior leaning experiences will usually make sense to them. Tobin continues with, "the findings related to the use of metaphors to conceptualize teaching roles raise the possibility that significant changes in classroom practice are possible if teachers are assisted to understand their teaching roles in terms of new metaphors." We believe, like him, that this approach to teacher education fosters change however, we also believe that teacher metaphor change is only one component of a very complex process. It is essential that we examine student metaphor usage and their preferred learning environment.

Significance of the Study

If we still believe that if there is a will to change, there is a way, then how do we facilitate change or reform at the classroom level? We believe that several factors facilitate teacher and curricula change. Teachers need adequate facilities and funding to develop research-oriented classrooms. A shared vision among the "voices" is essential. Only by negotiating this vision with all associated individuals (teacher, students, parents, administration, Akademe, and colleagues)will the teacher be able to facilitate change. This process will ensure that all those involved have a stake in the outcome. However, we must be aware that not all associated individuals will see a need for and accept change. We, who advocate change, sometimes feel frustration when students apparently do not value the opportunities we present to them. We value these opportunities because we feel the need to change and the necessity to provide our students with these opportunities. However, for the students it is a "given", and not necessarily a need, something they cannot value (Moscovici, 1992). Teachers need to recognize and understand the way in which their students perceive themselves as learners. They must accept that not all students will have the same vision of learning and that success and satisfaction of prior learning experiences will influence their students' willingness to, or resistance to, change.

References

American Association for the Advancement of Science (AAAS). (1989). Science for all Americans: Summary Project 2061. Washington, DC: Author

American Psychological Association (APA). (1981). Ethical principles of psychologists. American Psychologist, 36(6), 633-638.

Brickhouse, N. W. (1991). Ethics in field-based research: Ethical Principles and Relational Considerations. Science Education, 76(1), 93-103.

Educational Testing Services (ETS). (1988). The Science Report Card: Elements of Risk and Recovery (Report N. 17-S-01). Princeton, NJ: National Assessment of Educational Progress.

Morrison, E. S. (1988). Science Plus. Toronto, CAN: Bryant Press (HBJ).

Moscovici, H. (1992). From metaphor to a community of learners. Unpublished paper submitted to N. Presmeg at the Florida State University.

National Commission on Excellence in Education. (1983). A Nation at Risk. Washington, DC: U.S. Government Printing Office.

Schon, D. A. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Schon, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. San Francisco: Jossey-Bass.

Shulman, L. (1988). The Dangers of Dichotomous Thinking in Education. (In P. P. Grimmett & G. L. Erickson, Reflection in Teacher Education.) Vancouver, B.C. : Pacific Education Press.

Tobin, K. (1990). Changing Metaphors and Beliefs: A Master Switch for Teaching? Theory into Practice: Metaphors We Learn By. Spring: 122-127.

Tobin, K. (1991). Quote taken from SCE 6335 - Teaching and Learning Science. Fall Semester 1991, Florida State University.